Clear Sky **Rain**

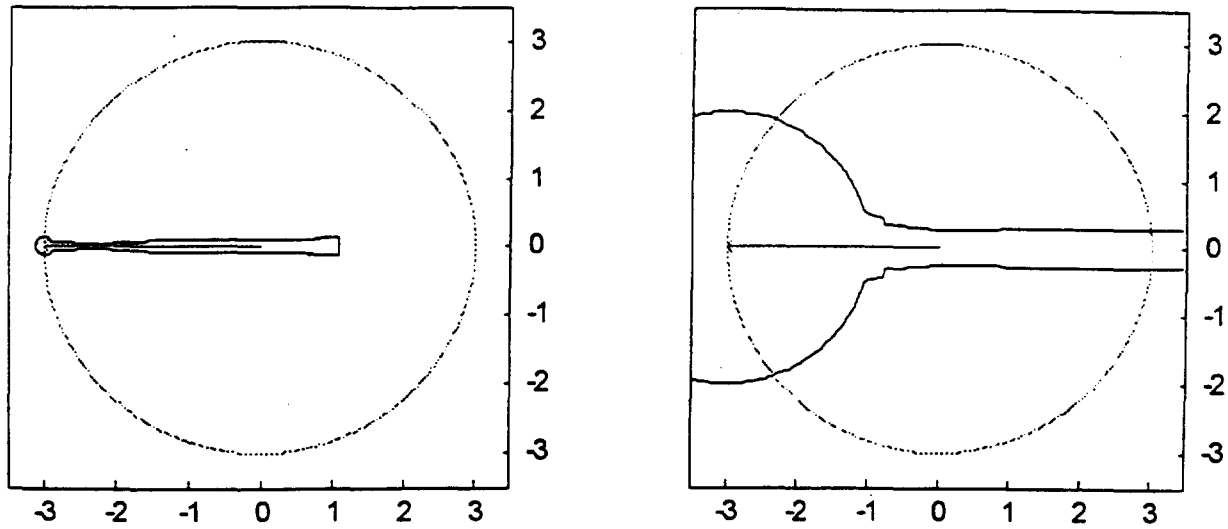


Figure 6.2-9 TST into TI-Sys1 hub-to-subscriber link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	0.85
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	15-3=12.00	36.00
Signal Bandwidth (MHz)	52.00	26.50
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	35-1=34	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	4.07	7.77
Sidelobe (45°) min. Clearance (mile)	0.129	1.99
Backlobe min. Clearance (mile)	0.129	1.99
Cell Availability (% of a cell)	97.5	72.5

Clear Sky **Rain**

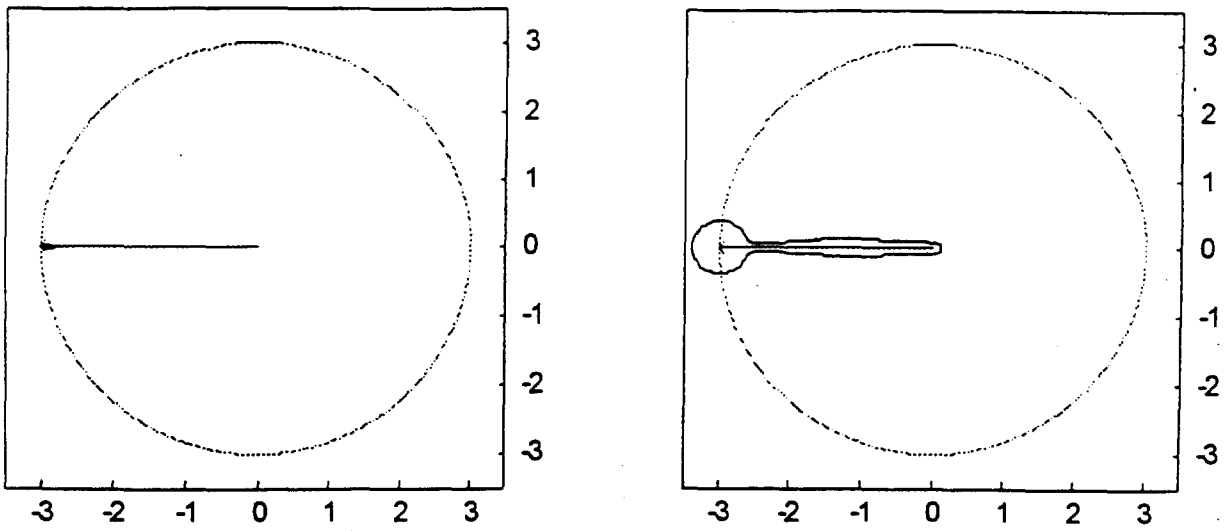


Figure 6.2-10 TGT into TI-Sys1 hub-to-subscriber link.

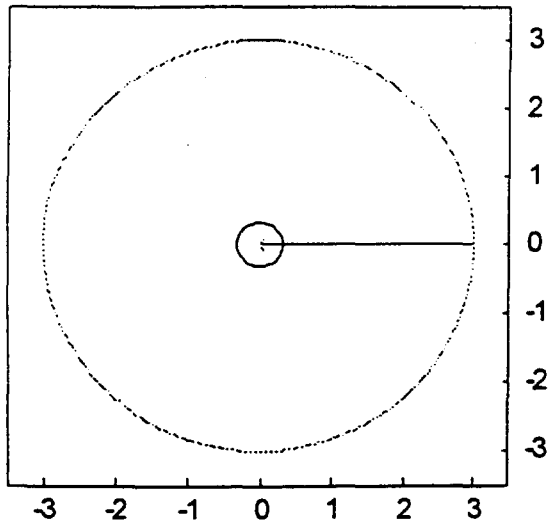
Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	-0.18
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	15-3=12.00	50.00
Signal Bandwidth (MHz)	52.00	800.00
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	35-1=34	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.336	3.11
Sidelobe (45°) min. Clearance (mile)	0.0106	0.397
Backlobe min. Clearance (mile)	0.0106	0.397
Cell Availability (% of a cell)	99.9	97.3

Clear Sky **Rain**



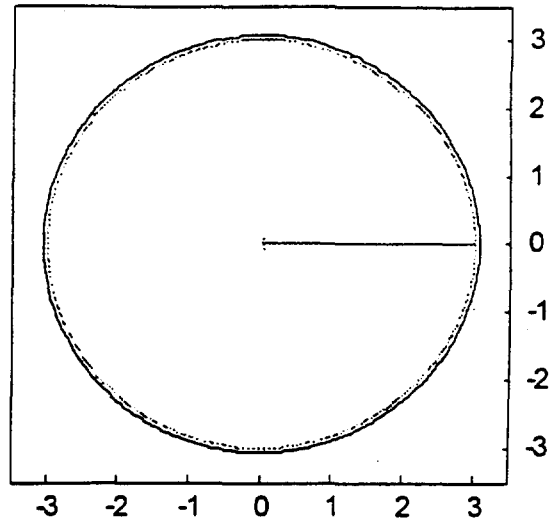


Figure 6.2-11 TST into TI-Sys1 subscriber-to-hub link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	0.85
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	35-1=34.00	36.00
Signal Bandwidth (MHz)	52.00	26.50
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	12.00	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.324	3.06
Sidelobe (45°) min. Clearance (mile)	0.324	3.06
Backlobe min. Clearance (mile)	0.324	3.06
Cell Availability (% of a cell)	98.8	0.0

Clear Sky **Rain**

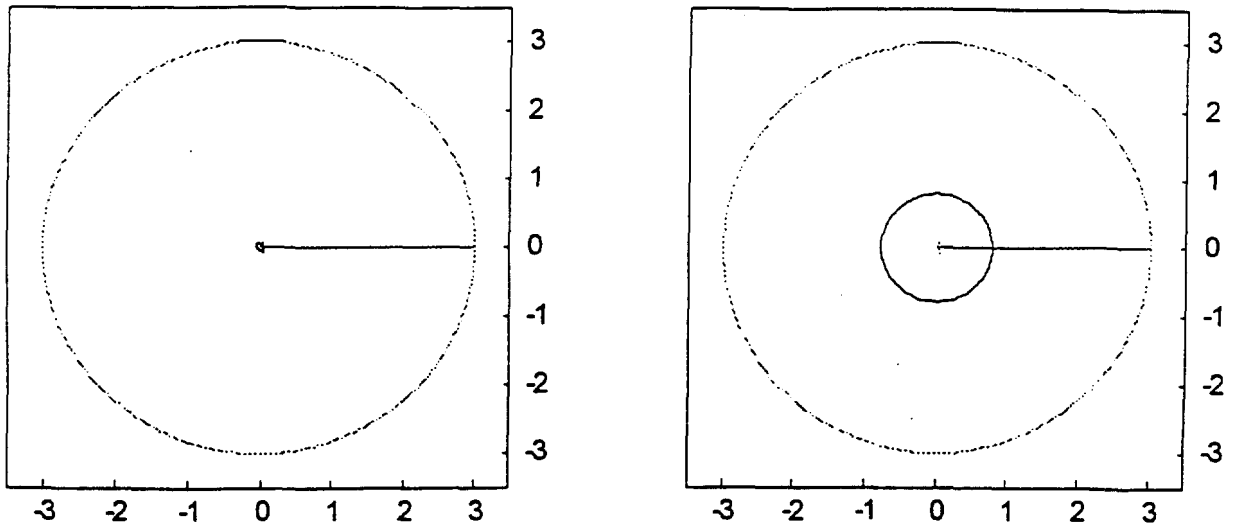


Figure 6.2-11 TGT into TI-Sys1 subscriber-to-hub link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	-0.18
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	35-1=34.00	50.00
Signal Bandwidth (MHz)	52.00	800.00
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	12.00	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.0267	0.789
Sidelobe (45°) min. Clearance (mile)	0.0267	0.789
Backlobe min. Clearance (mile)	0.0267	0.789
Cell Availability (% of a cell)	99.9	93.0

Clear Sky **Rain**

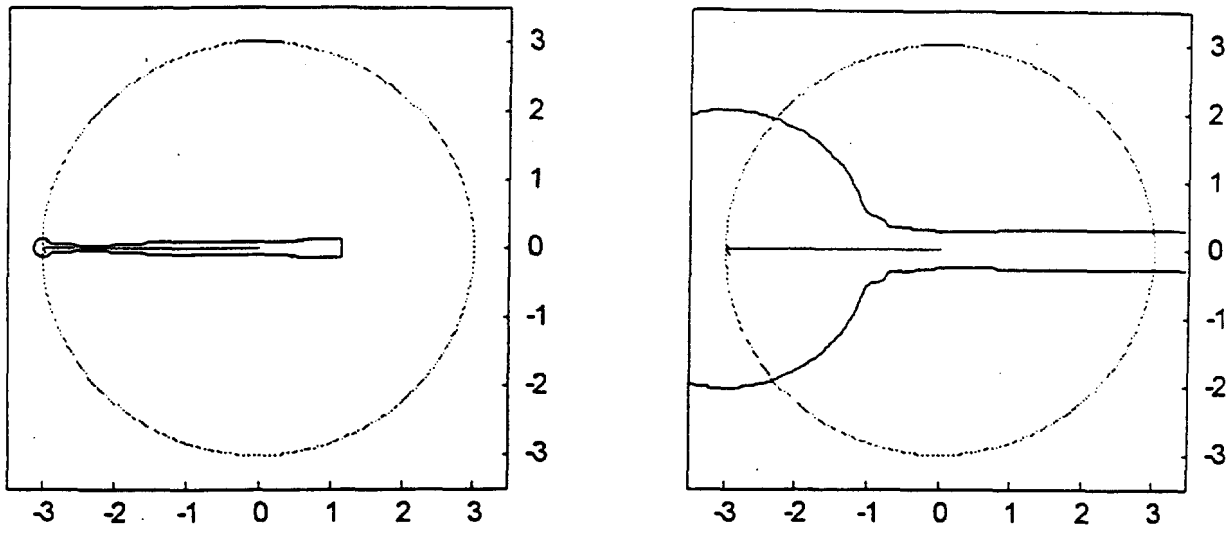


Figure 6.2-13 TST into TI-Sys3 hub-to-subscriber link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	0.85
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	15-3=12.00	36.00
Signal Bandwidth (MHz)	17.00	26.50
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	35-1=34	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	18.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	4.14	7.85
Sidelobe (45°) min. Clearance (mile)	0.131	2.03
Backlobe min. Clearance (mile)	0.131	2.03
Cell Availability (% of a cell)	97.3	71.9

Clear Sky **Rain**

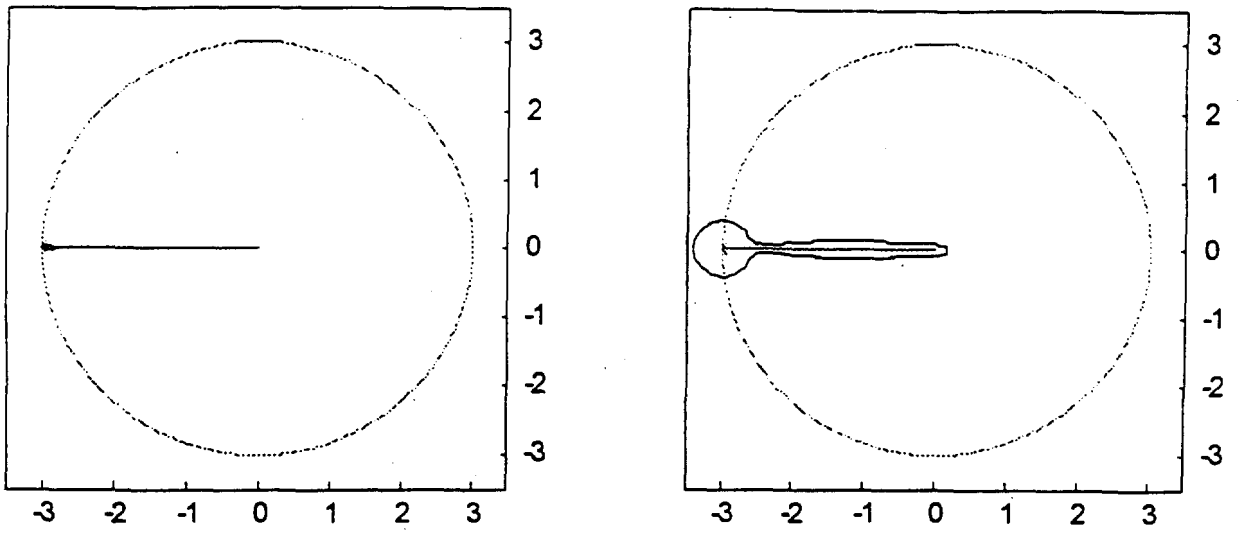


Figure 6.2-14 TGT into TI-Sys3 hub-to-subscriber link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	0.00	-0.18
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	15-3=12.00	50.00
Signal Bandwidth (MHz)	17.00	800.00
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	35-1=34	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	18.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.342	3.15
Sidelobe (45°) min. Clearance (mile)	0.0108	0.407
Backlobe min. Clearance (mile)	0.0108	0.407
Cell Availability (% of a cell)	99.9	97.1

Clear Sky **Rain**

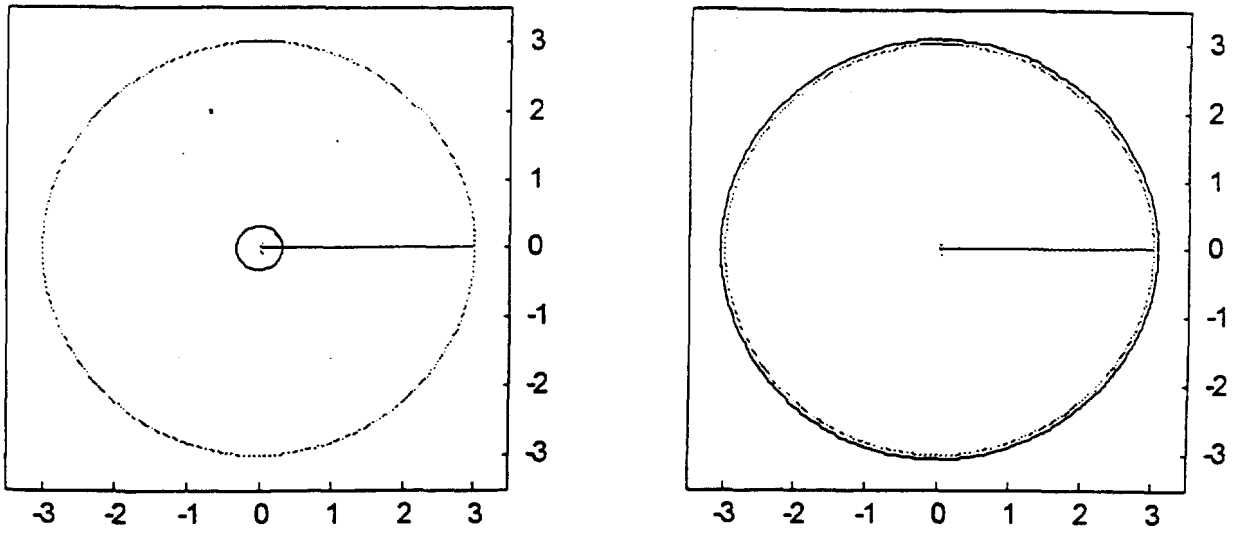


Figure 6.2-15. TST into TI-Sys3 subscriber-to-hub link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	-10.00	0.85
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	35-1=34.00	36.00
Signal Bandwidth (MHz)	5.20	26.50
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	12.00	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.324	3.06
Sidelobe (45°) min. Clearance (mile)	0.324	3.06
Backlobe min. Clearance (mile)	0.324	3.06
Cell Availability (% of a cell)	98.8	0.0

Clear Sky **Rain**

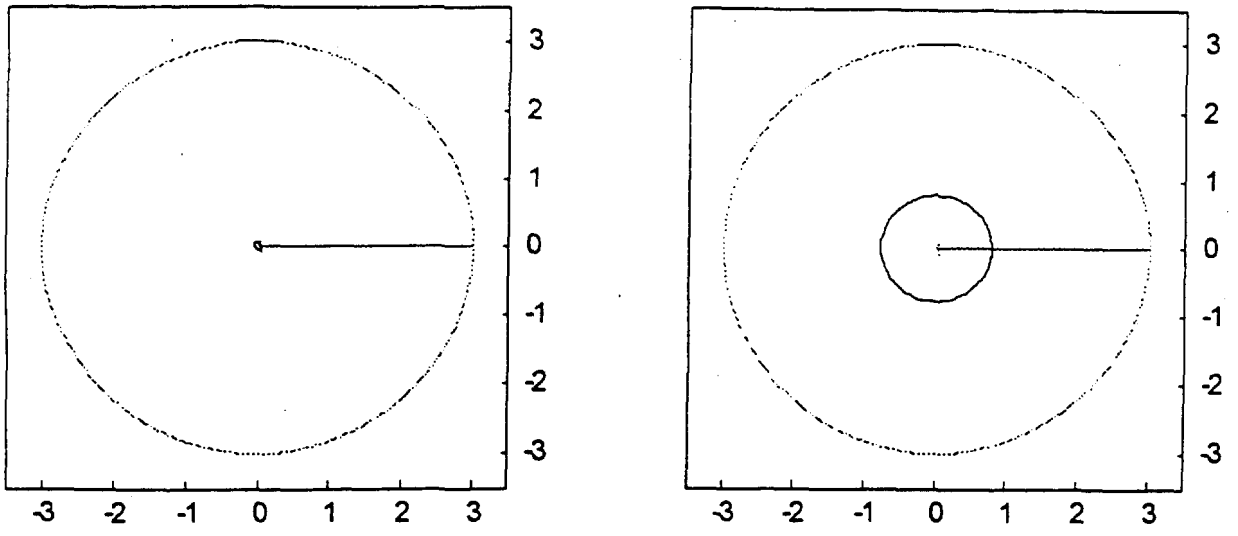


Figure 6.2-16. TGT into TI-Sys3 subscriber-to-hub link.

Parameter Summary

	Desired	Interference
Cell Size (miles)	3.00	
Transmit Power (dBW)	-10.0	-0.18
Power Increase in Rain (dB)	0.00	17.10
Transmit Antenna Peak Gain (dBi)	35-1=34.00	50.00
Signal Bandwidth (MHz)	5.20	800.00
Interference Antenna Elevation (deg)		40.00
Receive Antenna peak Gain (dBi)	12.00	
Noise Temperature (dB°K)	31.87	
Required C/(N+I) (dB)	13.00	

Analysis Result

	Clear Sky	Rain
Boresight min. Clearance (mile)	0.0267	0.789
Sidelobe (45°) min. Clearance (mile)	0.0267	0.789
Backlobe min. Clearance (mile)	0.0267	0.789
Cell Availability (% of a cell)	99.9	93.0

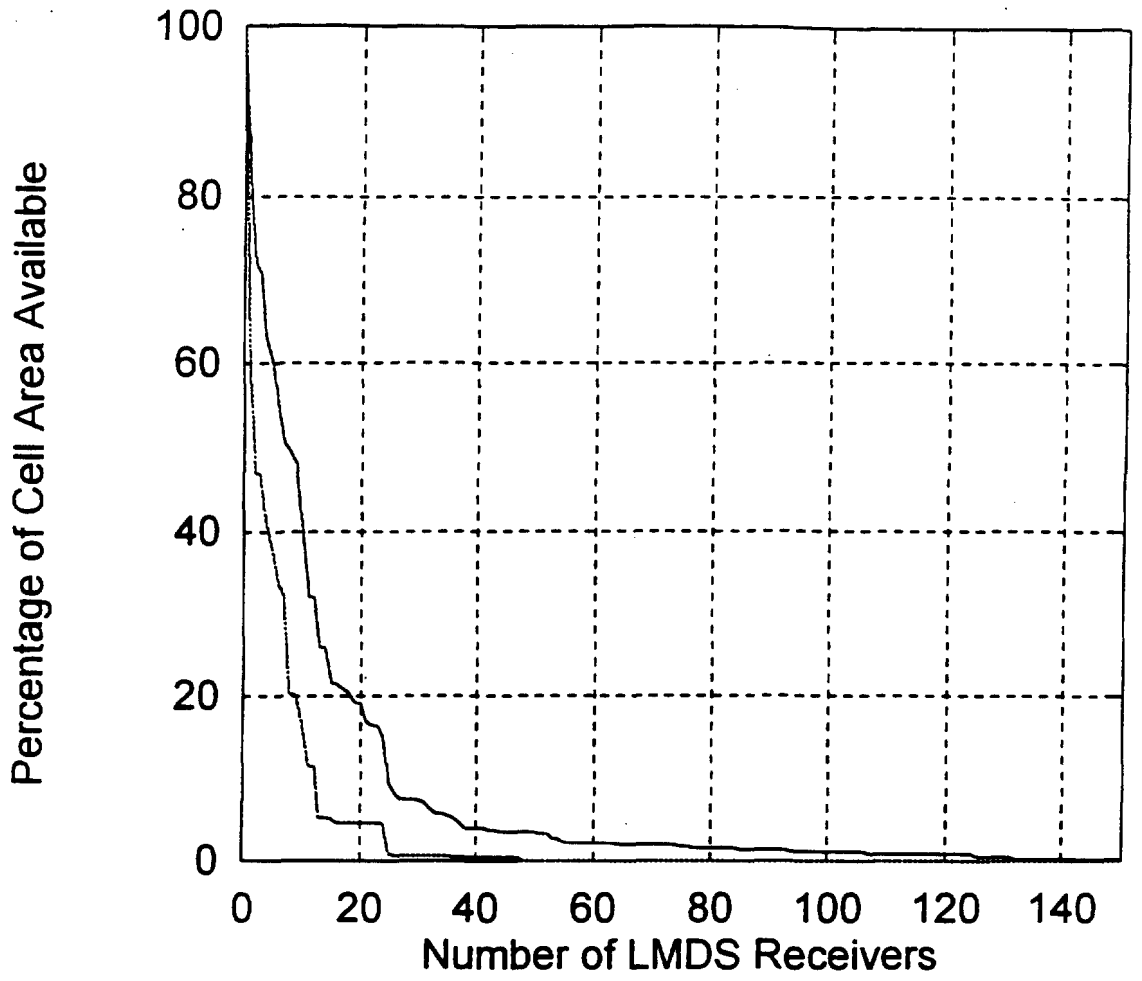


Figure 6.2-17 Percentage of CellularVision LMDS Cell Area where Teledesic can Operate TST without Interfering with LMDS Hub-to-Subcriber Link. The lower curve is computed in heavy rain condition and the upper curve is computed in clear sky condition.

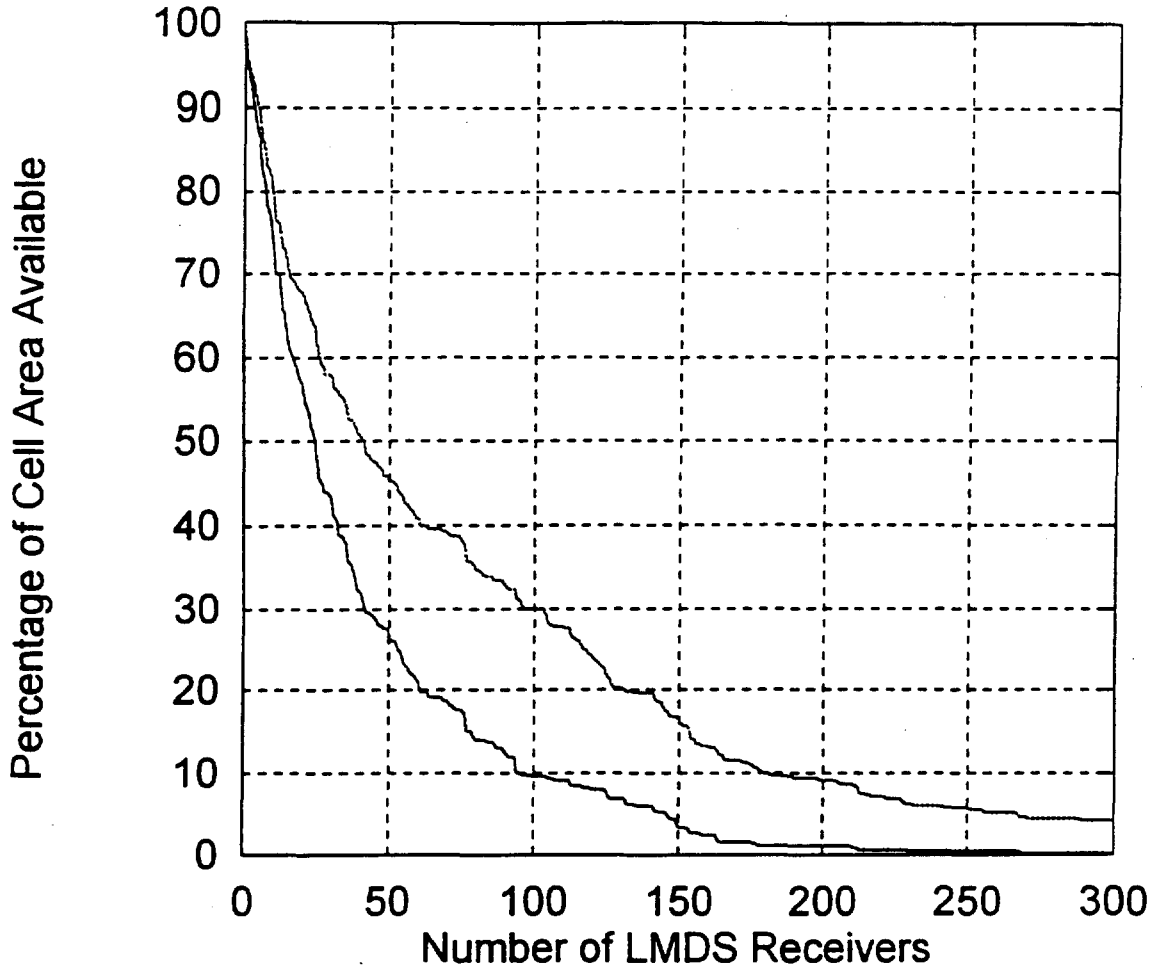


Figure 6.2-18 Percentage of Video/Phone LMDS Cell Area where Teledesic can Operate TST without Interfering with LMDS Hub-to-Subcriber Link. The upper curve is computed in heavy rain condition and the lower curve is computed in clear sky condition.

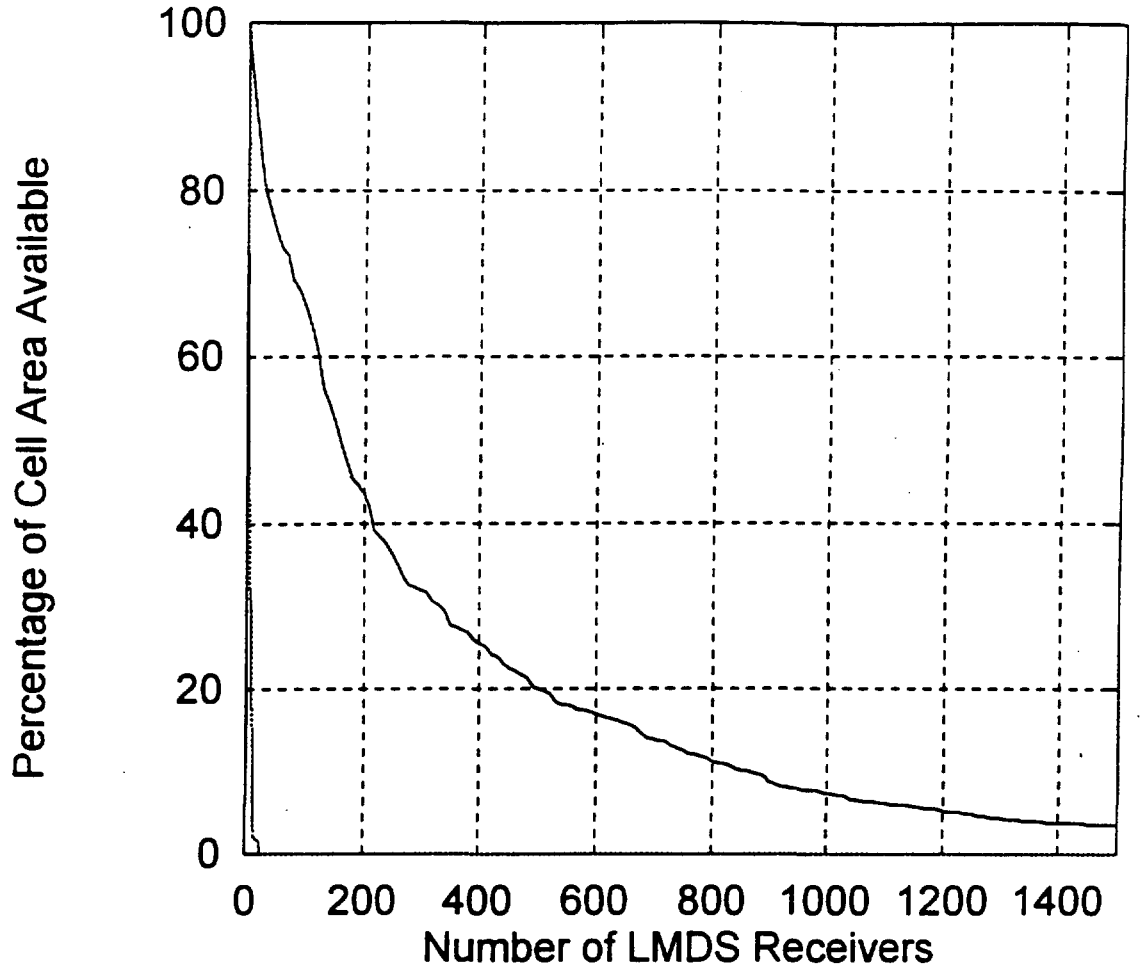


Figure 6.2-19 Percentage of TI (System 1, 52 Mbps) LMDS Cell Area where Teledesic can Operate TST without Interfering with LMDS Hub-to-Subcriber Link. The lower curve is computed in heavy rain condition and the upper curve is computed in clear sky condition.

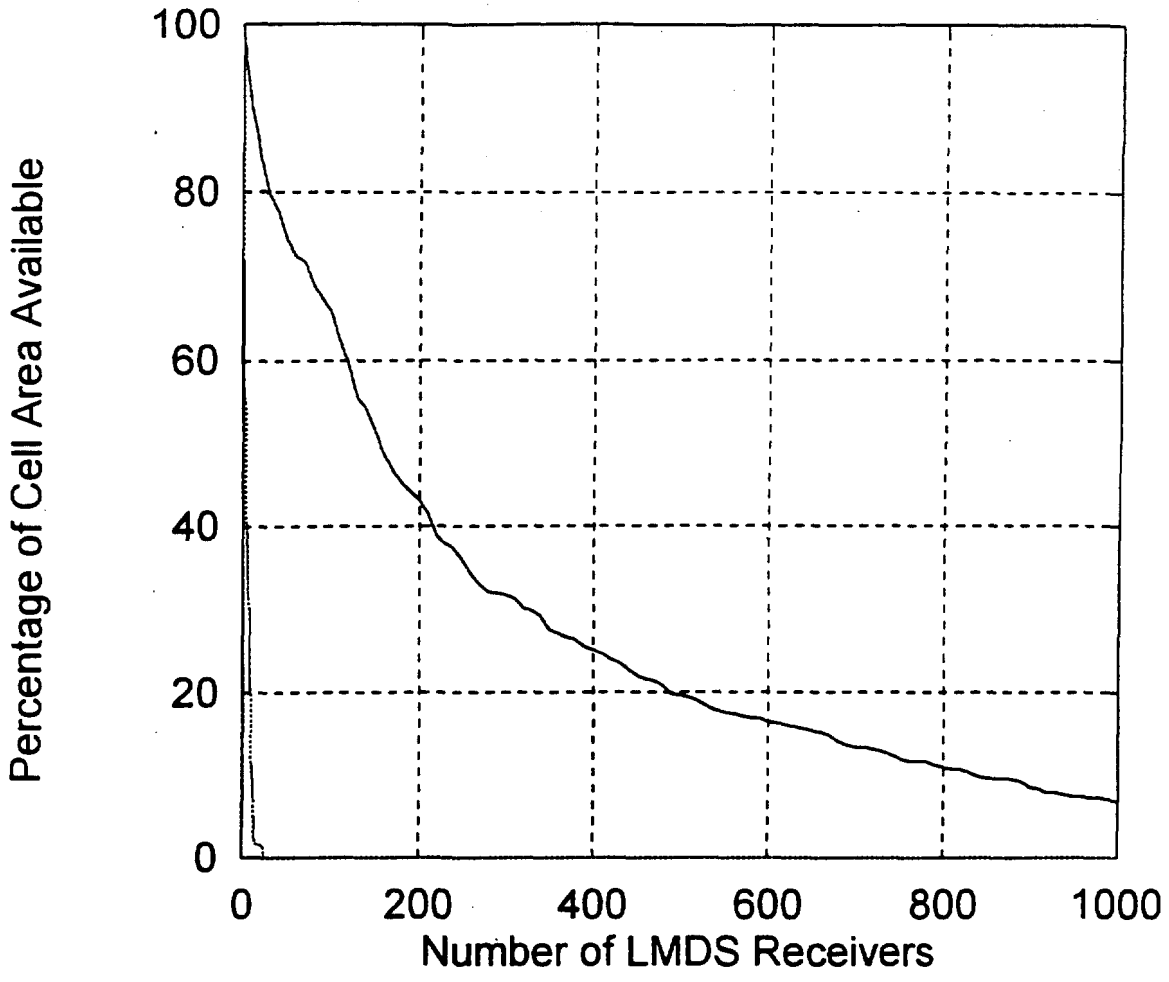


Figure 6.2-20 Percentage of TI (System 3, FM) LMDS Cell Area where Teledesic can Operate TST without Interfering with LMDS Hub-to-Subcriber Link. The lower curve is computed in heavy rain condition and the upper curve is computed in clear sky condition.

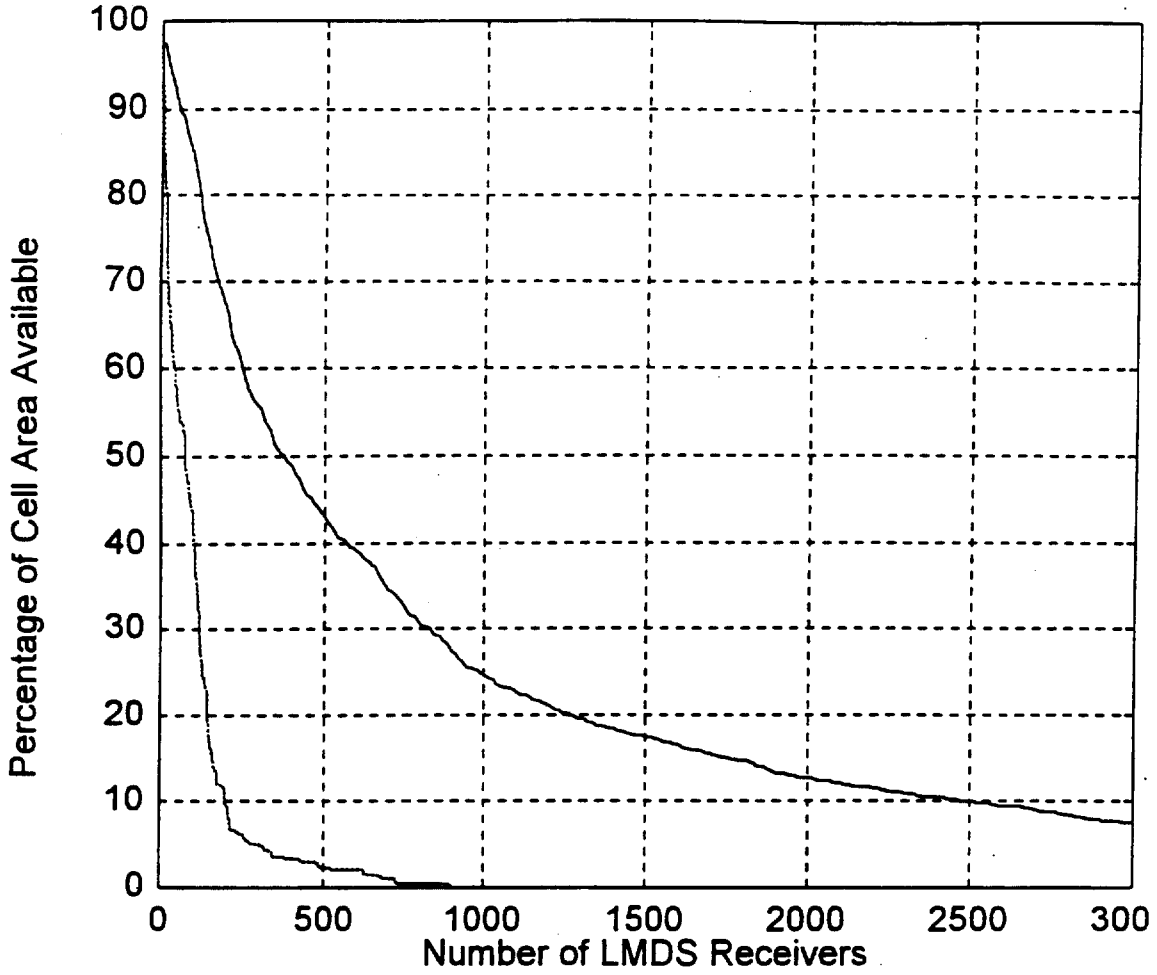


Figure 6.2-21 Percentage of CellularVision LMDS Cell Area where Teledesic can Operate TGT without Interfering with LMDS Hub-to-Subcriber Link. The lower curve is computed in heavy rain condition and the upper curve is computed in clear sky condition.

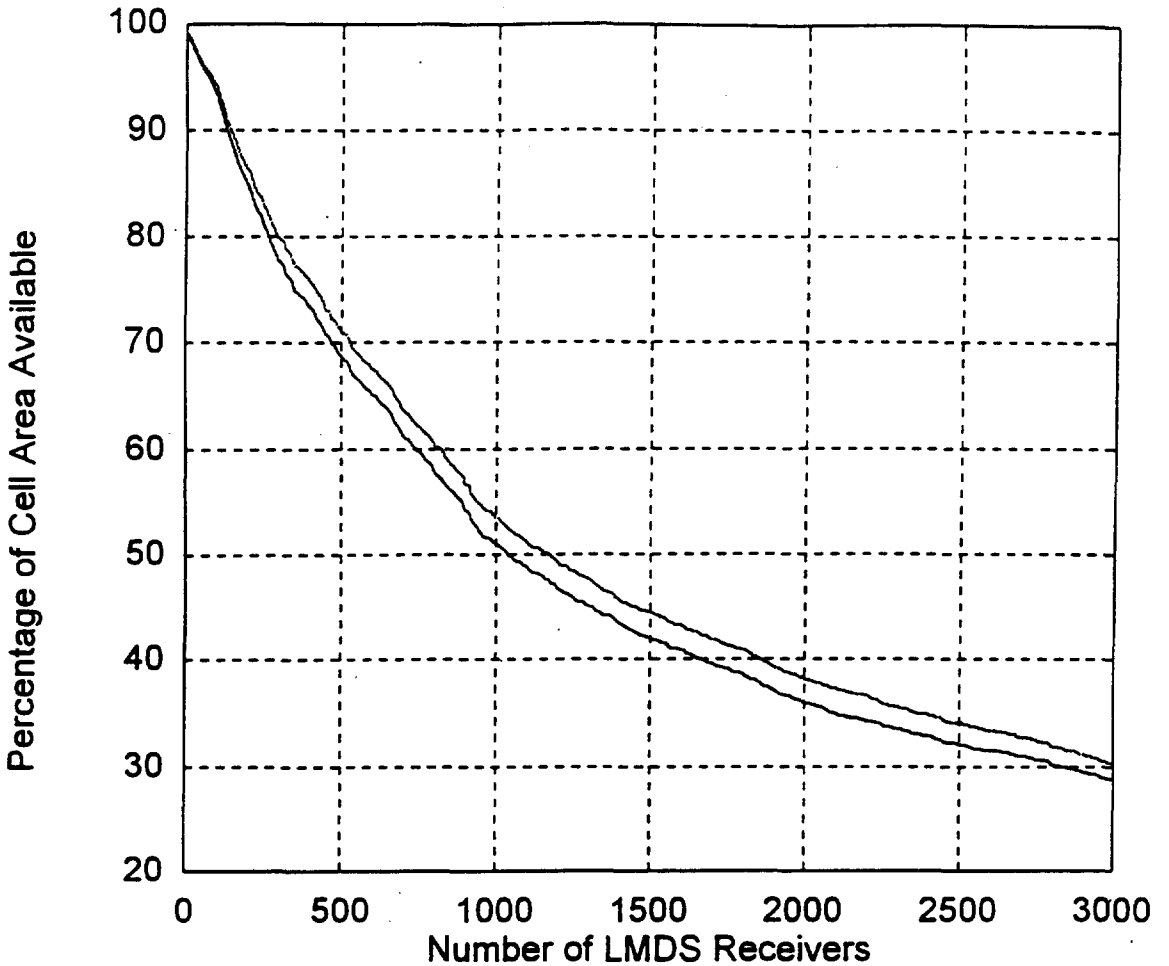


Figure 6.2-22 Percentage of Video/Phone LMDS Cell Area where Teledesic can Operate TGT without Interfering with LMDS Hub-to-Subcriber Link. The upper curve is computed in heavy rain condition and the lower curve is computed in clear sky condition.

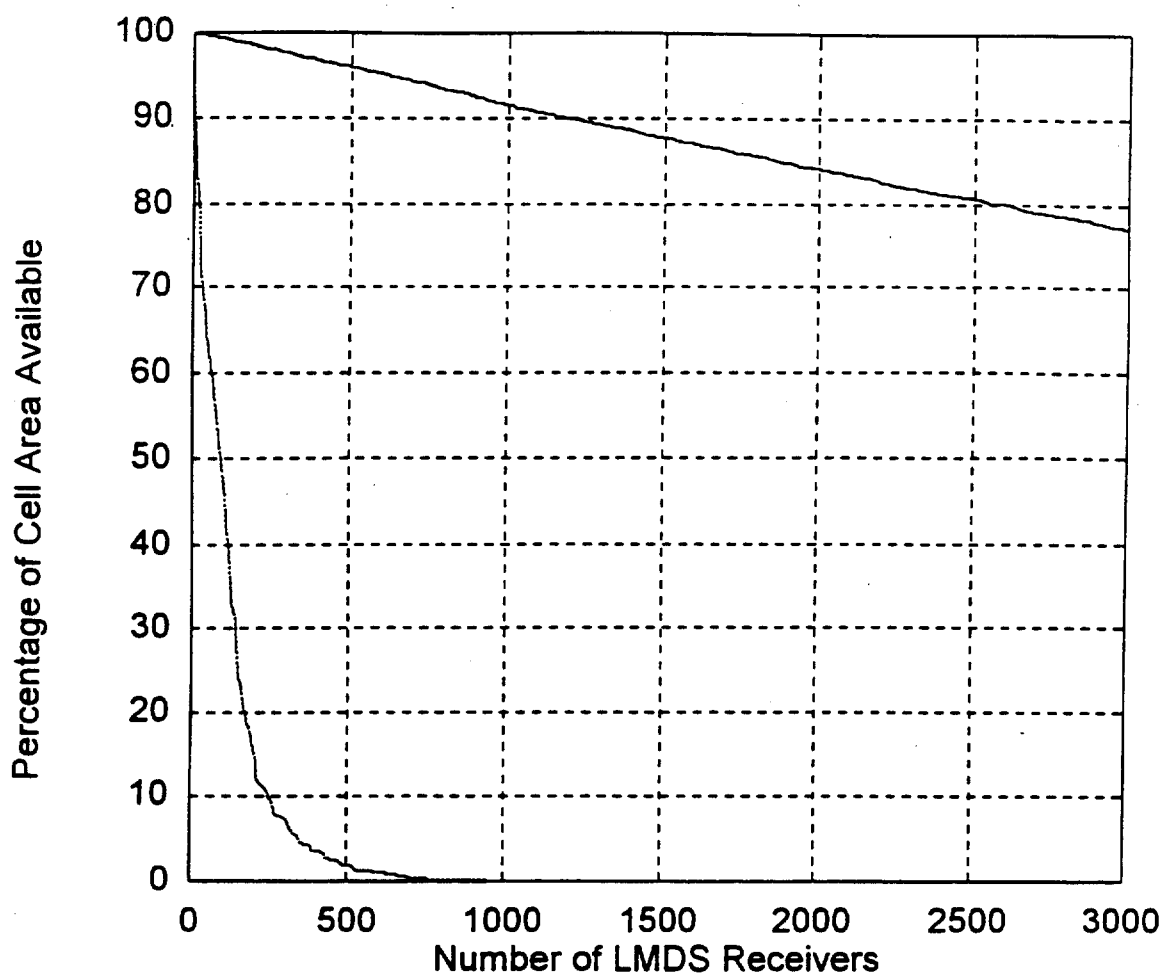


Figure 6.2-23 Percentage of TI (System 1, 52 Mbps) LMDS Cell Area where Teledesic can Operate TGT without Interfering with LMDS Hub-to-Subcriber Link. The lower curve is computed in heavy rain condition and the upper curve is computed in clear sky condition.

6.3 LMDS Interference into FSS Satellite Receivers

The worst-case interference scenario is where the FSS beam intersection with the Earth is at minimum elevation angle (least LMDS transmitter antenna discrimination). The only FSS NGSO proponent operates with a minimum elevation angle of 40• using a unique beam area that remains fixed on the Earth's surface. It was thus possible to use the same analysis and modeling methods described above for GSO FSS satellite receivers.

All of the LMDS proponents presented interactive systems where there are hub-to-subscriber transmissions and return subscriber-to-hub transmissions. Interference levels were computed and compared to allowed levels into FSS satellite receivers to determine interference margins for both cases.

An analysis of interference to the FSS from LMDS hub-to-subscriber transmissions is covered in detail in Document WG1/46 in Attachment I. Results are summarized here. A positive margin indicates that aggregate interference does not exceed the allowed value.

Summary of LMDS Hub Interference Margins into FSS Satellites

Limit/Io in dB	Suite 12	Video Phone	TI Digital	TI TV/FM	TI TV/AM
ACTS, 30• elev.	20	13	28	17	6
SPACEWAY, 30• elev.	16	9	24	12	2
TELEDESIC, 40• elev.	6	6	10	-2	-16
Typical Future GSO Satellites:					
Spot Beam, 20• elev.	15	5	23	11	1
CONUS, 20• elev.	22	16	33	21	11

With the exception of Texas Instrument (TI) TV signals, hub transmissions showed positive margins. The Teledesic FSS system is the most sensitive to interference. A smaller elevation angle (20•) that might be required to accomodate future FSS systems was also evaluated and results in reduced margins.

It should be noted that these results reflect unattenuated interference from 10% of the hubs operating at full rain-provoked power levels. In clear air, the margins improve by the following amounts:

Suite 12	Video/Phone	TI digital	TI TV/FM	TI TV/AM
0 dB	3 dB	4 dB	4 dB	0.5 dB

Thus, for clear air, all systems except TI TV/AM have positive margins.

An analysis of interference to the FSS from LMDS subscriber-to-hub transmissions is covered in detail in Document WG1/54 in Attachment J. Results are summarized here. A positive margin indicates that aggregate interference does not exceed the allowed value.

Summary of LMDS Subscriber Interference Margins into FSS Satellites

Limit/Io in dB	Suite 12	Video Phone	TI 5 km digital	TI 1 km digital
ACTS, 30• elev.	18	-3	17	17
SPACEWAY, 30• elev.	13	-7	13	13
TELEDESIC, 40• elev.	2	-11	-2	-5
Typical Future GSO Satellites:				
Spot Beam, 20• elev.	12	-9	11	12
CONUS, 20• elev.	19	2	22	22

The Teledesic system proved the most sensitive to interference. The Video/Phone system showed negative margins to most FSS systems due to its unique 36 sector receiving hub that allows up to 36 simultaneous co-channel subscriber transmissions within each cell. The other LMDS systems are limited to a single co-channel subscriber transmission within each cell at any given time. A smaller elevation angle (20•) that might be required to accomodate future FSS systems results in reduced margins.

It should be noted that these results reflect unattenuated interference from 10% of the hubs operating at full rain-provoked power levels. In clear air, the margins improve by the following amounts:

Suite 12	Video/Phone	TI 5 km dig	TI 1 km digital
0 dB	2.3 dB	2.5 dB	0.5 dB

6.4 FSS Power Control Beacons (Downlink) in The 27.5 - 29.5 MHz Band

Future satellites may employ beacons at 27.5005 GHz subject to the PFD limits of RR 2578. LMDS receivers could experience interference to narrow-band signals from beacon signals arriving at low elevation angles (< 25•) operating near the allowed PFD limit.

It was determined that the ACTS power control downlink beacon at 27.505 GHz is unlikely to cause interference to any LMDS receivers because of its relatively low PFD and minimum 30• elevation angle of arrival.

The question of LMDS transmitter interference to FSS Earth station reception of such beacon signals was also evaluated. Over the range of LMDS signal characteristics, a 17 to 138 km free-space separation would need to be maintained between LMDS transmitters and FSS Earth stations to prevent interference to the reception of the FSS beacon signal.

Detailed computations are covered in Document WG1/88 contained in Attachment K.

7.0 Conclusions

7.1 Working Group 1 Conclusions Concerning FSS Earth Station Transmitters Interfering Into LMDS Receivers

1. Working Group 1 did not find a technical solution, based on the system characteristics and methodologies considered, for co-frequency sharing between FSS and LMDS services that was deemed feasible by any combination of LMDS and FSS proponents.

2. Sharing problems, in large part, are due to the proposed widespread distribution of both FSS Earth stations and LMDS receivers throughout the same geographic areas, and the desire to impose minimal restrictions on the siting and operation of both.

3. The group considered all proposed solutions presented to it by the participants; however, none were deemed feasible by any combination of LMDS and FSS proponents.

4. In addition, a number of operational and interference mitigation techniques to assist sharing were identified. Modeling methods could not be developed, within the time frame allowed by this Committee's charter, to statistically assess the full impact of mitigating techniques and factors. Similarly, modeling methods to statistically and analytically assess the impact of environmental factors, and diffuse and specular scattering could not be developed in the time allowed.

7.2 Working Group 1 Conclusions Concerning LMDS Transmitters Interfering With FSS Satellite Receivers

1. Based on the system characteristics and methodologies considered, analyses have shown that in most cases, interferences from hub-to-subscriber transmissions for present LMDS and FSS system designs provide positive margins. One (AM video) out of 25 cases analyzed had a negative margin in clear air. For one additional case, a slight negative margin existed under intense rain conditions. In such cases of negative margin, mitigating factors or techniques need to be applied; however, they were not analyzed.

2. Based on the system characteristics and methodologies considered, subscriber-to-hub transmissions as modeled have five out of 25 cases with negative margins in clear air, but these margins are of smaller magnitude than those for hub-to-subscriber transmissions. For one additional case, a slight negative margin existed under intense rain conditions. In such cases of negative margin, mitigating factors or techniques need to be applied; however, they were not analyzed.

3. Based on the system characteristics and methodologies considered, aggregate limits on the power spectral density (dBW/Hz/km^2) can preclude interference to satellite receivers. Although discussions occurred concerning the form and content of compliance provisions, agreement could not be reached on the feasibility of enforcement.

CHARTER FOR THE LMDS/FSS 28 GHZ BAND NEGOTIATED RULEMAKING COMMITTEE

A. The Committee's Official Designation

The official designation of the advisory committee will be the "LMDS/FSS 28 GHz Band Negotiated Rulemaking Committee."

B. The Committee's Objective and Scope of its Activity

The purpose of the committee is to provide recommendations to the Federal Communications Commission to be used in the formulation of technical rules which should be adopted for the Local Multipoint Distribution Service (LMDS) and/or the Fixed Satellite Service (FSS) so as to maximize the co-frequency sharing of the 27.5 - 29.5 GHz frequency band ("28 GHz band") among these services. The scope of the activity of the committee will include all steps necessary to assemble data, perform analyses, and provide advice to the FCC concerning the technical and coordination issues presented by these services.

C. Period of Time Necessary for the Committee to Carry Out Its Purpose

The committee will require 60 days to carry out its purpose.

D. Official to Whom the Committee Reports

Chief, Common Carrier Bureau, Federal Communications Commission.

E. Agency Responsible for Providing Necessary Support

The Federal Communications Commission will provide the necessary support for the committee. The Federal Communications Commission will not provide facilities needed for the conduct of the meetings of the committee, except for the first meeting. Private sector members of the committee will serve without any government compensation, nor will they be entitled to travel expenses or per diem subsistence allowance. Committee members may choose to support a facilitator for the Committee.

F. Description of the Duties for Which the Committee is Responsible

The duties of the committee will be to gather and discuss information necessary to form recommendations to the FCC for technical regulations that should be adopted for the Local Multipoint Distribution Service and/or the Fixed Satellite

Service so as to maximize the co-frequency sharing of the spectrum among these services.

G. Estimated Operating Costs in Dollars and Staff Years

Estimated staff years that will be expended by the committee are 0.5 for the FCC staff and 4.3 for the private sector and other governmental representatives. The estimated cost to the FCC of operating the committee is $60,000, which includes a $25,000 contribution towards the cost of procuring a facilitator and/or for training committee members on negotiated rulemaking and consensus-building procedures.

H. Estimated Number and Frequency of Committee Meetings

Eight meetings of the full committee, with additional meetings of informal subcommittees, are expected.

I. Committee's Termination Date

The committee will terminate September 23, 1994.

J. Date Original Charter Filed

The original charter was filed July 26, 1994.

WORK PROGRAM

LMDS/FSS 28 GHz BAND NEGOTIATED RULEMAKING COMMITTEE

Provide Recommendations to be used in the formulation of technical rules in 47 C.F.R. Parts 21 and 25, either modifications to existing rules or new rules, so as to maximize the co-frequency sharing of the 27.5 - 29.5 GHz band between the Local Multipoint Distribution Service (LMDS) and the Fixed Satellite Service (FSS).

A. In order to determine the appropriate technical, operational and/or administrative sharing criteria that would maximize the co-frequency sharing of the band by the LMDS and the FSS, the Committee will assemble data, perform analyses and provide advice concerning the technical and coordination issues presented by these services. In this regard, the following sharing/compatibility cases should be examined:

1) FSS Earth station uplinks accessing geostationary satellites causing potential interference into LMDS hub stations and subscriber terminals.

2) FSS feeder uplink Earth stations accessing Low-Earth Orbit satellites providing mobile satellite services in the 1610-1626.5/2483.5-2500 MHz bands causing potential interference to LMDS hub stations and subscriber terminals.

3) FSS Earth station uplinks accessing Low-Earth Orbit FSS satellites causing potential interference to LMDS hub stations and subscriber terminals.

4) LMDS hub stations and subscriber terminals causing potential interference, on an individual station basis or as an aggregate of all visible subscriber terminals and hub stations, to FSS geostationary satellite receivers.

5) LMDS hub stations and subscriber terminals causing potential interference on an individual station basis or as an aggregate of all visible terminals and hub stations to FSS Low-Earth Orbit satellite receivers.

6) LMDS hub stations and subscriber terminals causing potential interference on an individual station basis or as an aggregate of all visible terminals and hub stations to feeder links for MSS services in the 1610-1626.5/2483.5-2500 MHz bands.

B. All recommendations or proposed rules must comply with International Telecommunication Union treaty obligations.